

SCSI Interfaces Guide

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SCSI Interfaces Guide

by James Bottomley and Rob Landley
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Chapter 1. Introduction

Protocol vs bus

Once upon a time, the Small Computer Systems Interface defined both a parallel I/O bus and a data protocol to connect a wide variety of peripherals (disk drives, tape drives, modems, printers, scanners, optical drives, test equipment, and medical devices) to a host computer.

Although the old parallel (fast/wide/ultra) SCSI bus has largely fallen out of use, the SCSI command set is more widely used than ever to communicate with devices over a number of different busses.

The SCSI protocol [<http://www.t10.org/scsi-3.htm>] is a big-endian peer-to-peer packet based protocol. SCSI commands are 6, 10, 12, or 16 bytes long, often followed by an associated data payload.

SCSI commands can be transported over just about any kind of bus, and are the default protocol for storage devices attached to USB, SATA, SAS, Fibre Channel, FireWire, and ATAPI devices. SCSI packets are also commonly exchanged over Infiniband, I20 [<http://i2o.shadowconnect.com/faq.php>], TCP/IP (iSCSI [<https://en.wikipedia.org/wiki/ISCSI>]), even Parallel ports [<http://cyberelk.net/tim/parport/parscsi.html>].

Design of the Linux SCSI subsystem

The SCSI subsystem uses a three layer design, with upper, mid, and low layers. Every operation involving the SCSI subsystem (such as reading a sector from a disk) uses one driver at each of the 3 levels: one upper layer driver, one lower layer driver, and the SCSI midlayer.

The SCSI upper layer provides the interface between userspace and the kernel, in the form of block and char device nodes for I/O and `ioctl()`. The SCSI lower layer contains drivers for specific hardware devices.

In between is the SCSI mid-layer, analogous to a network routing layer such as the IPv4 stack. The SCSI mid-layer routes a packet based data protocol between the upper layer's `/dev` nodes and the corresponding devices in the lower layer. It manages command queues, provides error handling and power management functions, and responds to `ioctl()` requests.

Chapter 2. SCSI upper layer

The upper layer supports the user-kernel interface by providing device nodes.

sd (SCSI Disk)

sd (sd_mod.o)

sr (SCSI CD-ROM)

sr (sr_mod.o)

st (SCSI Tape)

st (st.o)

sg (SCSI Generic)

sg (sg.o)

ch (SCSI Media Changer)

ch (ch.c)

Chapter 3. SCSI mid layer

SCSI midlayer implementation

`include/scsi/scsi_device.h`

Name

`shost_for_each_device` — iterate over all devices of a host

Synopsis

```
shost_for_each_device ( sdev, shost );
```

Arguments

sdev the struct `scsi_device` to use as a cursor

shost the struct `scsi_host` to iterate over

Description

Iterator that returns each device attached to *shost*. This loop takes a reference on each device and releases it at the end. If you break out of the loop, you must call `scsi_device_put(sdev)`.

Name

`__shost_for_each_device` — iterate over all devices of a host (UNLOCKED)

Synopsis

```
__shost_for_each_device ( sdev, shost );
```

Arguments

sdev the struct `scsi_device` to use as a cursor

shost the struct `scsi_host` to iterate over

Description

Iterator that returns each device attached to *shost*. It does `_not_` take a reference on the `scsi_device`, so the whole loop must be protected by `shost->host_lock`.

Note

The only reason to use this is because you need to access the device list in interrupt context. Otherwise you really want to use `shost_for_each_device` instead.

drivers/scsi/scsi.c

Main file for the SCSI midlayer.

Name

`scsi_cmd_get_serial` — Assign a serial number to a command

Synopsis

```
void scsi_cmd_get_serial (struct Scsi_Host * host, struct scsi_cmnd *  
cmd);
```

Arguments

host the scsi host

cmd command to assign serial number to

Description

a serial number identifies a request for error recovery and debugging purposes. Protected by the `Host_Lock` of host.

Name

`scsi_change_queue_depth` — change a device's queue depth

Synopsis

```
int scsi_change_queue_depth (struct scsi_device * sdev, int depth);
```

Arguments

sdev SCSI Device in question

depth number of commands allowed to be queued to the driver

Description

Sets the device queue depth and returns the new value.

Name

`scsi_track_queue_full` — track QUEUE_FULL events to adjust queue depth

Synopsis

```
int scsi_track_queue_full (struct scsi_device * sdev, int depth);
```

Arguments

sdev SCSI Device in question

depth Current number of outstanding SCSI commands on this device, not counting the one returned as QUEUE_FULL.

Description

This function will track successive QUEUE_FULL events on a specific SCSI device to determine if and when there is a need to adjust the queue depth on the device.

Returns

0 - No change needed, >0 - Adjust queue depth to this new depth, -1 - Drop back to untagged operation using `host->cmd_per_lun` as the untagged command depth

Lock Status

None held on entry

Notes

Low level drivers may call this at any time and we will do “The Right Thing.” We are interrupt context safe.

Name

`scsi_get_vpd_page` — Get Vital Product Data from a SCSI device

Synopsis

```
int scsi_get_vpd_page (struct scsi_device * sdev, u8 page, unsigned char  
* buf, int buf_len);
```

Arguments

<i>sdev</i>	The device to ask
<i>page</i>	Which Vital Product Data to return
<i>buf</i>	where to store the VPD
<i>buf_len</i>	number of bytes in the VPD buffer area

Description

SCSI devices may optionally supply Vital Product Data. Each 'page' of VPD is defined in the appropriate SCSI document (eg SPC, SBC). If the device supports this VPD page, this routine returns a pointer to a buffer containing the data from that page. The caller is responsible for calling `kfree` on this pointer when it is no longer needed. If we cannot retrieve the VPD page this routine returns `NULL`.

Name

`scsi_report_opcode` — Find out if a given command opcode is supported

Synopsis

```
int scsi_report_opcode (struct scsi_device * sdev, unsigned char *  
buffer, unsigned int len, unsigned char opcode);
```

Arguments

sdev scsi device to query

buffer scratch buffer (must be at least 20 bytes long)

len length of buffer

opcode opcode for command to look up

Description

Uses the REPORT SUPPORTED OPERATION CODES to look up the given opcode. Returns -EINVAL if RSOC fails, 0 if the command opcode is unsupported and 1 if the device claims to support the command.

Name

`scsi_device_get` — get an additional reference to a `scsi_device`

Synopsis

```
int scsi_device_get (struct scsi_device * sdev);
```

Arguments

sdev device to get a reference to

Description

Gets a reference to the `scsi_device` and increments the use count of the underlying LLDD module. You must hold `host_lock` of the parent `Scsi_Host` or already have a reference when calling this.

This will fail if a device is deleted or cancelled, or when the LLD module is in the process of being unloaded.

Name

`scsi_device_put` — release a reference to a `scsi_device`

Synopsis

```
void scsi_device_put (struct scsi_device * sdev);
```

Arguments

sdev device to release a reference on.

Description

Release a reference to the `scsi_device` and decrements the use count of the underlying LLDD module. The device is freed once the last user vanishes.

Name

`target_for_each_device` — helper to walk all devices of a target

Synopsis

```
void target_for_each_device (struct scsi_target * target, void * data,  
void (*fn) (struct scsi_device *, void *));
```

Arguments

target target whose devices we want to iterate over.

data Opaque passed to each function call.

fn Function to call on each device

Description

This traverses over each device of *target*. The devices have a reference that must be released by `scsi_host_put` when breaking out of the loop.

Name

`__target_for_each_device` — helper to walk all devices of a target (UNLOCKED)

Synopsis

```
void __target_for_each_device (struct scsi_target * target, void *  
data, void (*fn) (struct scsi_device *, void *));
```

Arguments

target target whose devices we want to iterate over.

data parameter for callback @fn

fn callback function that is invoked for each device

Description

This traverses over each device of *target*. It does `_not_` take a reference on the `scsi_device`, so the whole loop must be protected by `shost->host_lock`.

Note

The only reason why drivers would want to use this is because they need to access the device list in irq context. Otherwise you really want to use `target_for_each_device` instead.

Name

`__scsi_device_lookup_by_target` — find a device given the target (UNLOCKED)

Synopsis

```
struct scsi_device * __scsi_device_lookup_by_target (struct scsi_target  
* starget, u64 lun);
```

Arguments

starget SCSI target pointer

lun SCSI Logical Unit Number

Description

Looks up the `scsi_device` with the specified *lun* for a given *starget*. The returned `scsi_device` does not have an additional reference. You must hold the host's `host_lock` over this call and any access to the returned `scsi_device`. A `scsi_device` in state `SDEV_DEL` is skipped.

Note

The only reason why drivers should use this is because they need to access the device list in irq context. Otherwise you really want to use `scsi_device_lookup_by_target` instead.

Name

`scsi_device_lookup_by_target` — find a device given the target

Synopsis

```
struct scsi_device * scsi_device_lookup_by_target (struct scsi_target  
* starget, u64 lun);
```

Arguments

starget SCSI target pointer

lun SCSI Logical Unit Number

Description

Looks up the `scsi_device` with the specified *lun* for a given *starget*. The returned `scsi_device` has an additional reference that needs to be released with `scsi_device_put` once you're done with it.

Name

`__scsi_device_lookup` — find a device given the host (UNLOCKED)

Synopsis

```
struct scsi_device * __scsi_device_lookup (struct Scsi_Host * shost,  
      uint channel, uint id, u64 lun);
```

Arguments

<i>shost</i>	SCSI host pointer
<i>channel</i>	SCSI channel (zero if only one channel)
<i>id</i>	SCSI target number (physical unit number)
<i>lun</i>	SCSI Logical Unit Number

Description

Looks up the `scsi_device` with the specified *channel*, *id*, *lun* for a given host. The returned `scsi_device` does not have an additional reference. You must hold the host's `host_lock` over this call and any access to the returned `scsi_device`.

Note

The only reason why drivers would want to use this is because they need to access the device list in irq context. Otherwise you really want to use `scsi_device_lookup` instead.

Name

`scsi_device_lookup` — find a device given the host

Synopsis

```
struct scsi_device * scsi_device_lookup (struct Scsi_Host * shost, uint
channel, uint id, u64 lun);
```

Arguments

<i>shost</i>	SCSI host pointer
<i>channel</i>	SCSI channel (zero if only one channel)
<i>id</i>	SCSI target number (physical unit number)
<i>lun</i>	SCSI Logical Unit Number

Description

Looks up the `scsi_device` with the specified *channel*, *id*, *lun* for a given host. The returned `scsi_device` has an additional reference that needs to be released with `scsi_device_put` once you're done with it.

drivers/scsi/scsicam.c

SCSI Common Access Method [<http://www.t10.org/ftp/t10/drafts/cam/cam-r12b.pdf>] support functions, for use with `HDIO_GETGEO`, etc.

Name

`scsi_bios_ptable` — Read PC partition table out of first sector of device.

Synopsis

```
unsigned char * scsi_bios_ptable (struct block_device * dev);
```

Arguments

dev from this device

Description

Reads the first sector from the device and returns 0x42 bytes starting at offset 0x1be.

Returns

partition table in `kmalloc(GFP_KERNEL)` memory, or `NULL` on error.

Name

`scsicam_bios_param` — Determine geometry of a disk in cylinders/heads/sectors.

Synopsis

```
int scsicam_bios_param (struct block_device * bdev, sector_t capacity,  
int * ip);
```

Arguments

bdev which device

capacity size of the disk in sectors

ip return value: ip[0]=heads, ip[1]=sectors, ip[2]=cylinders

Description

determine the BIOS mapping/geometry used for a drive in a SCSI-CAM system, storing the results in `ip` as required by the `HDIO_GETGEO` `ioctl`.

Returns

-1 on failure, 0 on success.

Name

`scsi_partsize` — Parse cylinders/heads/sectors from PC partition table

Synopsis

```
int scsi_partsize (unsigned char * buf, unsigned long capacity, unsigned
int * cyls, unsigned int * hds, unsigned int * secs);
```

Arguments

buf partition table, see `scsi_bios_ptable`

capacity size of the disk in sectors

cyls put cylinders here

hds put heads here

secs put sectors here

Description

determine the BIOS mapping/geometry used to create the partition table, storing the results in `*cyls`, `*hds`, and `*secs`

Returns

-1 on failure, 0 on success.

drivers/scsi/scsi_error.c

Common SCSI error/timeout handling routines.

Name

`scsi_schedule_eh` — schedule EH for SCSI host

Synopsis

```
void scsi_schedule_eh (struct Scsi_Host * shost);
```

Arguments

shost SCSI host to invoke error handling on.

Description

Schedule SCSI EH without `scmd`.

Name

`scsi_block_when_processing_errors` — Prevent cmds from being queued.

Synopsis

```
int scsi_block_when_processing_errors (struct scsi_device * sdev);
```

Arguments

sdev Device on which we are performing recovery.

Description

We block until the host is out of error recovery, and then check to see whether the host or the device is offline.

Return value

0 when dev was taken offline by error recovery. 1 OK to proceed.

Name

`scsi_eh_prep_cmnd` — Save a scsi command info as part of error recovery

Synopsis

```
void scsi_eh_prep_cmnd (struct scsi_cmnd * scmd, struct scsi_eh_save *  
ses, unsigned char * cmnd, int cmnd_size, unsigned sense_bytes);
```

Arguments

<i>scmd</i>	SCSI command structure to hijack
<i>ses</i>	structure to save restore information
<i>cmnd</i>	CDB to send. Can be NULL if no new cmnd is needed
<i>cmnd_size</i>	size in bytes of <i>cmnd</i> (must be <= BLK_MAX_CDB)
<i>sense_bytes</i>	size of sense data to copy. or 0 (if != 0 <i>cmnd</i> is ignored)

Description

This function is used to save a scsi command information before re-execution as part of the error recovery process. If *sense_bytes* is 0 the command sent must be one that does not transfer any data. If *sense_bytes* != 0 *cmnd* is ignored and this functions sets up a REQUEST_SENSE command and *cmnd* buffers to read *sense_bytes* into *scmd->sense_buffer*.

Name

`scsi_eh_restore_cmnd` — Restore a scsi command info as part of error recovery

Synopsis

```
void scsi_eh_restore_cmnd (struct scsi_cmnd * scmd, struct scsi_eh_save  
* ses);
```

Arguments

scmd SCSI command structure to restore

ses saved information from a corresponding call to `scsi_eh_prep_cmnd`

Description

Undo any damage done by above `scsi_eh_prep_cmnd`.

Name

`scsi_eh_finish_cmd` — Handle a cmd that eh is finished with.

Synopsis

```
void scsi_eh_finish_cmd (struct scsi_cmnd * scmd, struct list_head *  
done_q);
```

Arguments

scmd Original SCSI cmd that eh has finished.

done_q Queue for processed commands.

Notes

We don't want to use the normal command completion while we are still handling errors - it may cause other commands to be queued, and that would disturb what we are doing. Thus we really want to keep a list of pending commands for final completion, and once we are ready to leave error handling we handle completion for real.

Name

`scsi_eh_get_sense` — Get device sense data.

Synopsis

```
int scsi_eh_get_sense (struct list_head * work_q, struct list_head *  
done_q);
```

Arguments

work_q Queue of commands to process.

done_q Queue of processed commands.

Description

See if we need to request sense information. if so, then get it now, so we have a better idea of what to do.

Notes

This has the unfortunate side effect that if a shost adapter does not automatically request sense information, we end up shutting it down before we request it.

All drivers should request sense information internally these days, so for now all I have to say is tough noogies if you end up in here.

XXX

Long term this code should go away, but that needs an audit of all LLDDs first.

Name

`scsi_eh_ready_devs` — check device ready state and recover if not.

Synopsis

```
void scsi_eh_ready_devs (struct Scsi_Host * shost, struct list_head *  
work_q, struct list_head * done_q);
```

Arguments

shost host to be recovered.

work_q list_head for pending commands.

done_q list_head for processed commands.

Name

`scsi_eh_flush_done_q` — finish processed commands or retry them.

Synopsis

```
void scsi_eh_flush_done_q (struct list_head * done_q);
```

Arguments

done_q list_head of processed commands.

Name

`scsi_ioctl_reset` —

Synopsis

```
int scsi_ioctl_reset (struct scsi_device * dev, int __user * arg);
```

Arguments

dev `scsi_device` to operate on

arg reset type (see `sg.h`)

Name

`scsi_get_sense_info_fld` — get information field from sense data (either fixed or descriptor format)

Synopsis

```
int scsi_get_sense_info_fld (const u8 * sense_buffer, int sb_len, u64  
* info_out);
```

Arguments

sense_buffer byte array of sense data

sb_len number of valid bytes in *sense_buffer*

info_out pointer to 64 integer where 8 or 4 byte information field will be placed if found.

Return value

1 if information field found, 0 if not found.

drivers/scsi/scsi_devinfo.c

Manage `scsi_dev_info_list`, which tracks blacklisted and whitelisted devices.

Name

`scsi_dev_info_list_add` — add one `dev_info` list entry.

Synopsis

```
int scsi_dev_info_list_add (int compatible, char * vendor, char * model,  
char * strflags, int flags);
```

Arguments

compatible if true, null terminate short strings. Otherwise space pad.

vendor vendor string

model model (product) string

strflags integer string

flags if *strflags* NULL, use this flag value

Description

Create and add one `dev_info` entry for *vendor*, *model*, *strflags* or *flag*. If *compatible*, add to the tail of the list, do not space pad, and set `devinfo->compatible`. The `scsi_static_device_list` entries are added with *compatible* 1 and *clflags* NULL.

Returns

0 OK, -error on failure.

Name

`scsi_dev_info_list_add_str` — parse `dev_list` and add to the `scsi_dev_info_list`.

Synopsis

```
int scsi_dev_info_list_add_str (char * dev_list);
```

Arguments

dev_list string of device flags to add

Description

Parse `dev_list`, and add entries to the `scsi_dev_info_list`. `dev_list` is of the form “vendor:product:flag,vendor:product:flag”. `dev_list` is modified via `strsep`. Can be called for command line addition, for `proc` or maybe a `sysfs` interface.

Returns

0 if OK, -error on failure.

Name

`scsi_get_device_flags` — get device specific flags from the dynamic device list.

Synopsis

```
int scsi_get_device_flags (struct scsi_device * sdev, const unsigned
char * vendor, const unsigned char * model);
```

Arguments

sdev `scsi_device` to get flags for

vendor vendor name

model model name

Description

Search the global `scsi_dev_info_list` (specified by list zero) for an entry matching *vendor* and *model*, if found, return the matching flags value, else return the host or global default settings. Called during scan time.

Name

`scsi_exit_devinfo` — remove `/proc/scsi/device_info` & the `scsi_dev_info_list`

Synopsis

```
void scsi_exit_devinfo ( void );
```

Arguments

void no arguments

Name

`scsi_init_devinfo` — set up the dynamic device list.

Synopsis

```
int scsi_init_devinfo ( void );
```

Arguments

void no arguments

Description

Add command line entries from `scsi_dev_flags`, then add `scsi_static_device_list` entries to the scsi device info list.

drivers/scsi/scsi_ioctl.c

Handle `ioctl()` calls for SCSI devices.

Name

`scsi_ioctl` — Dispatch ioctl to scsi device

Synopsis

```
int scsi_ioctl (struct scsi_device * sdev, int cmd, void __user * arg);
```

Arguments

sdev scsi device receiving ioctl

cmd which ioctl is it

arg data associated with ioctl

Description

The `scsi_ioctl` function differs from most ioctls in that it does not take a major/minor number as the `dev` field. Rather, it takes a pointer to a struct `scsi_device`.

drivers/scsi/scsi_lib.c

SCSI queuing library.

Name

`scsi_execute` — insert request and wait for the result

Synopsis

```
int scsi_execute (struct scsi_device * sdev, const unsigned char * cmd,
int data_direction, void * buffer, unsigned bufflen, unsigned char *
sense, int timeout, int retries, u64 flags, int * resid);
```

Arguments

<i>sdev</i>	scsi device
<i>cmd</i>	scsi command
<i>data_direction</i>	data direction
<i>buffer</i>	data buffer
<i>bufflen</i>	len of buffer
<i>sense</i>	optional sense buffer
<i>timeout</i>	request timeout in seconds
<i>retries</i>	number of times to retry request
<i>flags</i>	or into request flags;
<i>resid</i>	optional residual length

Description

returns the `req->errors` value which is the `scsi_cmnd` result field.

Name

`scsi_mode_select` — issue a mode select

Synopsis

```
int scsi_mode_select (struct scsi_device * sdev, int pf, int sp, int
modepage, unsigned char * buffer, int len, int timeout, int retries,
struct scsi_mode_data * data, struct scsi_sense_hdr * sshdr);
```

Arguments

<i>sdev</i>	SCSI device to be queried
<i>pf</i>	Page format bit (1 == standard, 0 == vendor specific)
<i>sp</i>	Save page bit (0 == don't save, 1 == save)
<i>modepage</i>	mode page being requested
<i>buffer</i>	request buffer (may not be smaller than eight bytes)
<i>len</i>	length of request buffer.
<i>timeout</i>	command timeout
<i>retries</i>	number of retries before failing
<i>data</i>	returns a structure abstracting the mode header data
<i>sshdr</i>	place to put sense data (or NULL if no sense to be collected). must be SCSI_SENSE_BUFFERSIZE big.

Description

Returns zero if successful; negative error number or scsi status on error

Name

`scsi_mode_sense` — issue a mode sense, falling back from 10 to six bytes if necessary.

Synopsis

```
int scsi_mode_sense (struct scsi_device * sdev, int dbd, int modepage,  
unsigned char * buffer, int len, int timeout, int retries, struct  
scsi_mode_data * data, struct scsi_sense_hdr * sshdr);
```

Arguments

<i>sdev</i>	SCSI device to be queried
<i>dbd</i>	set if mode sense will allow block descriptors to be returned
<i>modepage</i>	mode page being requested
<i>buffer</i>	request buffer (may not be smaller than eight bytes)
<i>len</i>	length of request buffer.
<i>timeout</i>	command timeout
<i>retries</i>	number of retries before failing
<i>data</i>	returns a structure abstracting the mode header data
<i>sshdr</i>	place to put sense data (or NULL if no sense to be collected). must be SCSI_SENSE_BUFFERSIZE big.

Description

Returns zero if unsuccessful, or the header offset (either 4 or 8 depending on whether a six or ten byte command was issued) if successful.

Name

`scsi_test_unit_ready` — test if unit is ready

Synopsis

```
int scsi_test_unit_ready (struct scsi_device * sdev, int timeout, int
retries, struct scsi_sense_hdr * sshdr_external);
```

Arguments

<i>sdev</i>	scsi device to change the state of.
<i>timeout</i>	command timeout
<i>retries</i>	number of retries before failing
<i>sshdr_external</i>	Optional pointer to struct <code>scsi_sense_hdr</code> for returning sense. Make sure that this is cleared before passing in.

Description

Returns zero if unsuccessful or an error if TUR failed. For removable media, `UNIT_ATTENTION` sets ->changed flag.

Name

`scsi_device_set_state` — Take the given device through the device state model.

Synopsis

```
int scsi_device_set_state (struct scsi_device * sdev, enum
scsi_device_state state);
```

Arguments

sdev scsi device to change the state of.

state state to change to.

Description

Returns zero if unsuccessful or an error if the requested transition is illegal.

Name

`sdev_evt_send` — send asserted event to uevent thread

Synopsis

```
void sdev_evt_send (struct scsi_device * sdev, struct scsi_event * evt);
```

Arguments

sdev `scsi_device` event occurred on

evt event to send

Description

Assert scsi device event asynchronously.

Name

`sdev_evt_alloc` — allocate a new scsi event

Synopsis

```
struct scsi_event * sdev_evt_alloc (enum scsi_device_event evt_type,  
gfp_t gfpflags);
```

Arguments

evt_type type of event to allocate

gfpflags GFP flags for allocation

Description

Allocates and returns a new `scsi_event`.

Name

`sdev_evt_send_simple` — send asserted event to uevent thread

Synopsis

```
void sdev_evt_send_simple (struct scsi_device * sdev, enum  
scsi_device_event evt_type, gfp_t gfpflags);
```

Arguments

sdev `scsi_device` event occurred on

evt_type type of event to send

gfpflags GFP flags for allocation

Description

Assert scsi device event asynchronously, given an event type.

Name

`scsi_device_quiesce` — Block user issued commands.

Synopsis

```
int scsi_device_quiesce (struct scsi_device * sdev);
```

Arguments

sdev scsi device to quiesce.

Description

This works by trying to transition to the `SDEV_QUIESCE` state (which must be a legal transition). When the device is in this state, only special requests will be accepted, all others will be deferred. Since special requests may also be requeued requests, a successful return doesn't guarantee the device will be totally quiescent.

Must be called with user context, may sleep.

Returns zero if unsuccessful or an error if not.

Name

`scsi_device_resume` — Restart user issued commands to a quiesced device.

Synopsis

```
void scsi_device_resume (struct scsi_device * sdev);
```

Arguments

sdev scsi device to resume.

Description

Moves the device from quiesced back to running and restarts the queues.

Must be called with user context, may sleep.

Name

`scsi_internal_device_block` — internal function to put a device temporarily into the SDEV_BLOCK state

Synopsis

```
int scsi_internal_device_block (struct scsi_device * sdev);
```

Arguments

sdev device to block

Description

Block request made by scsi lld's to temporarily stop all scsi commands on the specified device. Called from interrupt or normal process context.

Returns zero if successful or error if not

Notes

This routine transitions the device to the SDEV_BLOCK state (which must be a legal transition). When the device is in this state, all commands are deferred until the scsi lld reenables the device with `scsi_device_unblock` or `device_block_tmo` fires.

Name

`scsi_internal_device_unblock` — resume a device after a block request

Synopsis

```
int scsi_internal_device_unblock (struct scsi_device * sdev, enum  
scsi_device_state new_state);
```

Arguments

sdev device to resume

new_state state to set devices to after unblocking

Description

Called by scsi lld's or the midlayer to restart the device queue for the previously suspended scsi device. Called from interrupt or normal process context.

Returns zero if successful or error if not.

Notes

This routine transitions the device to the SDEV_RUNNING state or to one of the offline states (which must be a legal transition) allowing the midlayer to goose the queue for this device.

Name

`scsi_kmap_atomic_sg` — find and atomically map an sg-element

Synopsis

```
void * scsi_kmap_atomic_sg (struct scatterlist * sgl, int sg_count,  
size_t * offset, size_t * len);
```

Arguments

<i>sgl</i>	scatter-gather list
<i>sg_count</i>	number of segments in sg
<i>offset</i>	offset in bytes into sg, on return offset into the mapped area
<i>len</i>	bytes to map, on return number of bytes mapped

Description

Returns virtual address of the start of the mapped page

Name

`scsi_kunmap_atomic_sg` — atomically unmap a virtual address, previously mapped with `scsi_kmap_atomic_sg`

Synopsis

```
void scsi_kunmap_atomic_sg (void * virt);
```

Arguments

virt virtual address to be unmapped

drivers/scsi/scsi_lib_dma.c

SCSI library functions depending on DMA (map and unmap scatter-gather lists).

Name

`scsi_dma_map` — perform DMA mapping against command's sg lists

Synopsis

```
int scsi_dma_map (struct scsi_cmnd * cmd);
```

Arguments

cmd scsi command

Description

Returns the number of sg lists actually used, zero if the sg lists is NULL, or -ENOMEM if the mapping failed.

Name

`scsi_dma_unmap` — unmap command's sg lists mapped by `scsi_dma_map`

Synopsis

```
void scsi_dma_unmap (struct scsi_cmnd * cmd);
```

Arguments

cmd scsi command

drivers/scsi/scsi_module.c

The file `drivers/scsi/scsi_module.c` contains legacy support for old-style host templates. It should never be used by any new driver.

drivers/scsi/scsi_proc.c

The functions in this file provide an interface between the PROC file system and the SCSI device drivers. It is mainly used for debugging, statistics and to pass information directly to the lowlevel driver. I.E. plumbing to manage `/proc/scsi/*`

Name

`scsi_proc_hostdir_add` — Create directory in /proc for a scsi host

Synopsis

```
void scsi_proc_hostdir_add (struct scsi_host_template * sht);
```

Arguments

sht owner of this directory

Description

Sets `sht->proc_dir` to the new directory.

Name

`scsi_proc_hostdir_rm` — remove directory in /proc for a scsi host

Synopsis

```
void scsi_proc_hostdir_rm (struct scsi_host_template * sht);
```

Arguments

sht owner of directory

Name

`scsi_proc_host_add` — Add entry for this host to appropriate /proc dir

Synopsis

```
void scsi_proc_host_add (struct Scsi_Host * shost);
```

Arguments

shost host to add

Name

`scsi_proc_host_rm` — remove this host's entry from /proc

Synopsis

```
void scsi_proc_host_rm (struct Scsi_Host * shost);
```

Arguments

shost which host

Name

`proc_print_scsidevice` — return data about this host

Synopsis

```
int proc_print_scsidevice (struct device * dev, void * data);
```

Arguments

dev A scsi device

data struct seq_file to output to.

Description

prints Host, Channel, Id, Lun, Vendor, Model, Rev, Type, and revision.

Name

`scsi_add_single_device` — Respond to user request to probe for/add device

Synopsis

```
int scsi_add_single_device (uint host, uint channel, uint id, uint lun);
```

Arguments

host user-supplied decimal integer

channel user-supplied decimal integer

id user-supplied decimal integer

lun user-supplied decimal integer

Description

called by writing “scsi add-single-device” to `/proc/scsi/scsi`.

does `scsi_host_lookup` and either `user_scan` if that transport type supports it, or else `scsi_scan_host_selected`

Note

this seems to be aimed exclusively at SCSI parallel busses.

Name

`scsi_remove_single_device` — Respond to user request to remove a device

Synopsis

```
int scsi_remove_single_device (uint host, uint channel, uint id, uint  
lun);
```

Arguments

host user-supplied decimal integer

channel user-supplied decimal integer

id user-supplied decimal integer

lun user-supplied decimal integer

Description

called by writing “scsi remove-single-device” to `/proc/scsi/scsi`. Does a `scsi_device_lookup` and `scsi_remove_device`

Name

`proc_scsi_write` — handle writes to `/proc/scsi/scsi`

Synopsis

```
ssize_t proc_scsi_write (struct file * file, const char __user * buf,
size_t length, loff_t * ppos);
```

Arguments

<i>file</i>	not used
<i>buf</i>	buffer to write
<i>length</i>	length of <i>buf</i> , at most <code>PAGE_SIZE</code>
<i>ppos</i>	not used

Description

this provides a legacy mechanism to add or remove devices by Host, Channel, ID, and Lun. To use, “echo 'scsi add-single-device 0 1 2 3' > /proc/scsi/scsi” or “echo 'scsi remove-single-device 0 1 2 3' > /proc/scsi/scsi” with “0 1 2 3” replaced by the Host, Channel, Id, and Lun.

Note

this seems to be aimed at parallel SCSI. Most modern busses (USB, SATA, Firewire, Fibre Channel, etc) dynamically assign these values to provide a unique identifier and nothing more.

Name

`proc_scsi_open` — glue function

Synopsis

```
int proc_scsi_open (struct inode * inode, struct file * file);
```

Arguments

inode not used

file passed to `single_open`

Description

Associates `proc_scsi_show` with this file

Name

`scsi_init_procfs` — create `scsi` and `scsi/scsi` in `procfs`

Synopsis

```
int scsi_init_procfs ( void );
```

Arguments

void no arguments

Name

`scsi_exit_procfs` — Remove `scsi/scsi` and `scsi` from `procfs`

Synopsis

```
void scsi_exit_procfs ( void );
```

Arguments

void no arguments

drivers/scsi/scsi_netlink.c

Infrastructure to provide async events from transports to userspace via netlink, using a single `NETLINK_SCSITRANSPORT` protocol for all transports. See the original patch submission [<http://marc.info/?l=linux-scsi&m=115507374832500&w=2>] for more details.

Name

`scsi_nl_rcv_msg` — Receive message handler.

Synopsis

```
void scsi_nl_rcv_msg (struct sk_buff * skb);
```

Arguments

skb socket receive buffer

Description

Extracts message from a receive buffer. Validates message header and calls appropriate transport message handler

Name

`scsi_netlink_init` — Called by SCSI subsystem to initialize the SCSI transport netlink interface

Synopsis

```
void scsi_netlink_init ( void );
```

Arguments

void no arguments

Name

`scsi_netlink_exit` — Called by SCSI subsystem to disable the SCSI transport netlink interface

Synopsis

```
void scsi_netlink_exit ( void );
```

Arguments

void no arguments

Description

drivers/scsi/scsi_scan.c

Scan a host to determine which (if any) devices are attached. The general scanning/probing algorithm is as follows, exceptions are made to it depending on device specific flags, compilation options, and global variable (boot or module load time) settings. A specific LUN is scanned via an INQUIRY command; if the LUN has a device attached, a `scsi_device` is allocated and setup for it. For every id of every channel on the given host, start by scanning LUN 0. Skip hosts that don't respond at all to a scan of LUN 0. Otherwise, if LUN 0 has a device attached, allocate and setup a `scsi_device` for it. If target is SCSI-3 or up, issue a REPORT LUN, and scan all of the LUNs returned by the REPORT LUN; else, sequentially scan LUNs up until some maximum is reached, or a LUN is seen that cannot have a device attached to it.

Name

`scsi_complete_async_scans` — Wait for asynchronous scans to complete

Synopsis

```
int scsi_complete_async_scans ( void );
```

Arguments

void no arguments

Description

When this function returns, any host which started scanning before this function was called will have finished its scan. Hosts which started scanning after this function was called may or may not have finished.

Name

`scsi_unlock_floptical` — unlock device via a special MODE SENSE command

Synopsis

```
void scsi_unlock_floptical (struct scsi_device * sdev, unsigned char  
* result);
```

Arguments

sdev scsi device to send command to

result area to store the result of the MODE SENSE

Description

Send a vendor specific MODE SENSE (not a MODE SELECT) command. Called for BLIST_KEY devices.

Name

`scsi_alloc_sdev` — allocate and setup a `scsi_Device`

Synopsis

```
struct scsi_device * scsi_alloc_sdev (struct scsi_target * starget, u64
lun, void * hostdata);
```

Arguments

starget which target to allocate a `scsi_device` for

lun which lun

hostdata usually NULL and set by `->slave_alloc` instead

Description

Allocate, initialize for io, and return a pointer to a `scsi_Device`. Stores the *shost*, *channel*, *id*, and *lun* in the `scsi_Device`, and adds `scsi_Device` to the appropriate list.

Return value

`scsi_Device` pointer, or NULL on failure.

Name

`scsi_target_reap_ref_release` — remove target from visibility

Synopsis

```
void scsi_target_reap_ref_release (struct kref * kref);
```

Arguments

kref the reap_ref in the target being released

Description

Called on last put of reap_ref, which is the indication that no device under this target is visible anymore, so render the target invisible in sysfs. Note: we have to be in user context here because the target reaps should be done in places where the scsi device visibility is being removed.

Name

`scsi_alloc_target` — allocate a new or find an existing target

Synopsis

```
struct scsi_target * scsi_alloc_target (struct device * parent, int
channel, uint id);
```

Arguments

parent parent of the target (need not be a scsi host)

channel target channel number (zero if no channels)

id target id number

Description

Return an existing target if one exists, provided it hasn't already gone into `STARGET_DEL` state, otherwise allocate a new target.

The target is returned with an incremented reference, so the caller is responsible for both reaping and doing a last put

Name

`scsi_target_reap` — check to see if target is in use and destroy if not

Synopsis

```
void scsi_target_reap (struct scsi_target * starget);
```

Arguments

starget target to be checked

Description

This is used after removing a LUN or doing a last put of the target it checks atomically that nothing is using the target and removes it if so.

Name

`sanitize_inquiry_string` — remove non-graphical chars from an INQUIRY result string

Synopsis

```
void sanitize_inquiry_string (unsigned char * s, int len);
```

Arguments

s INQUIRY result string to sanitize

len length of the string

Description

The SCSI spec says that INQUIRY vendor, product, and revision strings must consist entirely of graphic ASCII characters, padded on the right with spaces. Since not all devices obey this rule, we will replace non-graphic or non-ASCII characters with spaces. Exception: a NUL character is interpreted as a string terminator, so all the following characters are set to spaces.

Name

`scsi_probe_lun` — probe a single LUN using a SCSI INQUIRY

Synopsis

```
int scsi_probe_lun (struct scsi_device * sdev, unsigned char *  
inq_result, int result_len, int * bflags);
```

Arguments

<i>sdev</i>	scsi_device to probe
<i>inq_result</i>	area to store the INQUIRY result
<i>result_len</i>	len of <i>inq_result</i>
<i>bflags</i>	store any bflags found here

Description

Probe the lun associated with *req* using a standard SCSI INQUIRY;

If the INQUIRY is successful, zero is returned and the INQUIRY data is in *inq_result*; the *scsi_level* and INQUIRY length are copied to the *scsi_device* any flags value is stored in **bflags*.

Name

`scsi_add_lun` — allocate and fully initialize a `scsi_device`

Synopsis

```
int scsi_add_lun (struct scsi_device * sdev, unsigned char * inq_result,  
int * bflags, int async);
```

Arguments

sdev holds information to be stored in the new `scsi_device`

inq_result holds the result of a previous INQUIRY to the LUN

bflags black/white list flag

async 1 if this device is being scanned asynchronously

Description

Initialize the `scsi_device` *sdev*. Optionally set fields based on values in **bflags*.

SCSI_SCAN_NO_RESPONSE

could not allocate or setup a `scsi_device`

SCSI_SCAN_LUN_PRESENT

a new `scsi_device` was allocated and initialized

Name

`scsi_inq_str` — print INQUIRY data from min to max index, strip trailing whitespace

Synopsis

```
unsigned char * scsi_inq_str (unsigned char * buf, unsigned char * inq,  
unsigned first, unsigned end);
```

Arguments

buf Output buffer with at least `end-first+1` bytes of space

inq Inquiry buffer (input)

first Offset of string into `inq`

end Index after last character in `inq`

Name

`scsi_probe_and_add_lun` — probe a LUN, if a LUN is found add it

Synopsis

```
int scsi_probe_and_add_lun (struct scsi_target * starget, u64 lun, int  
* bflagsp, struct scsi_device ** sdevp, int rescan, void * hostdata);
```

Arguments

<i>starget</i>	pointer to target device structure
<i>lun</i>	LUN of target device
<i>bflagsp</i>	store bflags here if not NULL
<i>sdevp</i>	probe the LUN corresponding to this <code>scsi_device</code>
<i>rescan</i>	if nonzero skip some code only needed on first scan
<i>hostdata</i>	passed to <code>scsi_alloc_sdev</code>

Description

Call `scsi_probe_lun`, if a LUN with an attached device is found, allocate and set it up by calling `scsi_add_lun`.

SCSI_SCAN_NO_RESPONSE

could not allocate or setup a `scsi_device`

SCSI_SCAN_TARGET_PRESENT

target responded, but no device is attached at the LUN

SCSI_SCAN_LUN_PRESENT

a new `scsi_device` was allocated and initialized

Name

`scsi_sequential_lun_scan` — sequentially scan a SCSI target

Synopsis

```
void scsi_sequential_lun_scan (struct scsi_target * starget, int bflags,  
int scsi_level, int rescan);
```

Arguments

<i>starget</i>	pointer to target structure to scan
<i>bflags</i>	black/white list flag for LUN 0
<i>scsi_level</i>	Which version of the standard does this device adhere to
<i>rescan</i>	passed to <code>scsi_probe_add_lun</code>

Description

Generally, scan from LUN 1 (LUN 0 is assumed to already have been scanned) to some maximum lun until a LUN is found with no device attached. Use the bflags to figure out any oddities.

Modifies `sdevscan->lun`.

Name

`scsi_report_lun_scan` — Scan using SCSI REPORT LUN results

Synopsis

```
int scsi_report_lun_scan (struct scsi_target * target, int bflags, int rescan);
```

Arguments

target which target

bflags Zero or a mix of BLIST_NOLUN, BLIST_REPORTLUN2, or BLIST_NOREPORTLUN

rescan nonzero if we can skip code only needed on first scan

Description

Fast scanning for modern (SCSI-3) devices by sending a REPORT LUN command. Scan the resulting list of LUNs by calling `scsi_probe_and_add_lun`.

If BLINK_REPORTLUN2 is set, scan a target that supports more than 8 LUNs even if it's older than SCSI-3. If BLIST_NOREPORTLUN is set, return 1 always. If BLIST_NOLUN is set, return 0 always. If `target->no_report_luns` is set, return 1 always.

0

scan completed (or no memory, so further scanning is futile)

1

could not scan with REPORT LUN

Name

`scsi_prep_async_scan` — prepare for an async scan

Synopsis

```
struct async_scan_data * scsi_prep_async_scan (struct Scsi_Host *  
shost);
```

Arguments

shost the host which will be scanned

Returns

a cookie to be passed to `scsi_finish_async_scan`

Tells the midlayer this host is going to do an asynchronous scan. It reserves the host's position in the scanning list and ensures that other asynchronous scans started after this one won't affect the ordering of the discovered devices.

Name

`scsi_finish_async_scan` — asynchronous scan has finished

Synopsis

```
void scsi_finish_async_scan (struct async_scan_data * data);
```

Arguments

data cookie returned from earlier call to `scsi_prep_async_scan`

Description

All the devices currently attached to this host have been found. This function announces all the devices it has found to the rest of the system.

drivers/scsi/scsi_sysctl.c

Set up the sysctl entry: `"/dev/scsi/logging_level"` (`DEV_SCSI_LOGGING_LEVEL`) which sets/returns `scsi_logging_level`.

drivers/scsi/scsi_sysfs.c

SCSI sysfs interface routines.

Name

`scsi_remove_device` — unregister a device from the scsi bus

Synopsis

```
void scsi_remove_device (struct scsi_device * sdev);
```

Arguments

sdev `scsi_device` to unregister

Name

`scsi_remove_target` — try to remove a target and all its devices

Synopsis

```
void scsi_remove_target (struct device * dev);
```

Arguments

dev generic starget or parent of generic stargets to be removed

Note

This is slightly racy. It is possible that if the user requests the addition of another device then the target won't be removed.

drivers/scsi/hosts.c

mid to lowlevel SCSI driver interface

Name

`scsi_host_set_state` — Take the given host through the host state model.

Synopsis

```
int scsi_host_set_state (struct Scsi_Host * shost, enum scsi_host_state  
state);
```

Arguments

shost scsi host to change the state of.

state state to change to.

Description

Returns zero if unsuccessful or an error if the requested transition is illegal.

Name

`scsi_remove_host` — remove a scsi host

Synopsis

```
void scsi_remove_host (struct Scsi_Host * shost);
```

Arguments

shost a pointer to a scsi host to remove

Name

`scsi_add_host_with_dma` — add a scsi host with dma device

Synopsis

```
int scsi_add_host_with_dma (struct Scsi_Host * shost, struct device *  
dev, struct device * dma_dev);
```

Arguments

shost scsi host pointer to add

dev a struct device of type scsi class

dma_dev dma device for the host

Note

You rarely need to worry about this unless you're in a virtualised host environments, so use the simpler `scsi_add_host` function instead.

Return value

0 on success / != 0 for error

Name

`scsi_host_alloc` — register a scsi host adapter instance.

Synopsis

```
struct Scsi_Host * scsi_host_alloc (struct scsi_host_template * sht,  
int privsize);
```

Arguments

sht pointer to scsi host template

privsize extra bytes to allocate for driver

Note

Allocate a new `Scsi_Host` and perform basic initialization. The host is not published to the scsi midlayer until `scsi_add_host` is called.

Return value

Pointer to a new `Scsi_Host`

Name

`scsi_host_lookup` — get a reference to a `Scsi_Host` by host no

Synopsis

```
struct Scsi_Host * scsi_host_lookup (unsigned short hostnum);
```

Arguments

hostnum host number to locate

Return value

A pointer to located `Scsi_Host` or `NULL`.

The caller must do a `scsi_host_put` to drop the reference that `scsi_host_get` took. The `put_device` below dropped the reference from `class_find_device`.

Name

`scsi_host_get` — inc a Scsi_Host ref count

Synopsis

```
struct Scsi_Host * scsi_host_get (struct Scsi_Host * shost);
```

Arguments

shost Pointer to Scsi_Host to inc.

Name

`scsi_host_put` — dec a Scsi_Host ref count

Synopsis

```
void scsi_host_put (struct Scsi_Host * shost);
```

Arguments

shost Pointer to Scsi_Host to dec.

Name

`scsi_queue_work` — Queue work to the `Scsi_Host` workqueue.

Synopsis

```
int scsi_queue_work (struct Scsi_Host * shost, struct work_struct *  
work);
```

Arguments

shost Pointer to `Scsi_Host`.

work Work to queue for execution.

Return value

1 - work queued for execution
0 - work is already queued
-EINVAL - work queue doesn't exist

Name

`scsi_flush_work` — Flush a `Scsi_Host`'s workqueue.

Synopsis

```
void scsi_flush_work (struct Scsi_Host * shost);
```

Arguments

shost Pointer to `Scsi_Host`.

drivers/scsi/constants.c

mid to lowlevel SCSI driver interface

Name

/usr/src/linux-4.3.0-rc4-5.g9595e28//drivers/scsi/constants.c — Document generation inconsistency

Oops

Warning

The template for this document tried to insert the structured comment from the file `/usr/src/linux-4.3.0-rc4-5.g9595e28//drivers/scsi/constants.c` at this point, but none was found. This dummy section is inserted to allow generation to continue.

Transport classes

Transport classes are service libraries for drivers in the SCSI lower layer, which expose transport attributes in sysfs.

Fibre Channel transport

The file `drivers/scsi/scsi_transport_fc.c` defines transport attributes for Fibre Channel.

Name

`fc_get_event_number` — Obtain the next sequential FC event number

Synopsis

```
u32 fc_get_event_number ( void );
```

Arguments

void no arguments

Notes

We could have inlined this, but it would have required `fc_event_seq` to be exposed. For now, live with the subroutine call. Atomic used to avoid lock/unlock...

Name

`fc_host_post_event` — called to post an even on an `fc_host`.

Synopsis

```
void fc_host_post_event (struct Scsi_Host * shost, u32 event_number,  
enum fc_host_event_code event_code, u32 event_data);
```

Arguments

<i>shost</i>	host the event occurred on
<i>event_number</i>	fc event number obtained from <code>get_fc_event_number</code>
<i>event_code</i>	fc_host event being posted
<i>event_data</i>	32bits of data for the event being posted

Notes

This routine assumes no locks are held on entry.

Name

`fc_host_post_vendor_event` — called to post a vendor unique event on an `fc_host`

Synopsis

```
void fc_host_post_vendor_event (struct Scsi_Host * shost, u32
event_number, u32 data_len, char * data_buf, u64 vendor_id);
```

Arguments

<i>shost</i>	host the event occurred on
<i>event_number</i>	fc event number obtained from <code>get_fc_event_number</code>
<i>data_len</i>	amount, in bytes, of vendor unique data
<i>data_buf</i>	pointer to vendor unique data
<i>vendor_id</i>	Vendor id

Notes

This routine assumes no locks are held on entry.

Name

`fc_remove_host` — called to terminate any `fc_transport`-related elements for a scsi host.

Synopsis

```
void fc_remove_host (struct Scsi_Host * shost);
```

Arguments

shost Which `Scsi_Host`

Description

This routine is expected to be called immediately preceding the a driver's call to `scsi_remove_host`.

WARNING

A driver utilizing the `fc_transport`, which fails to call this routine prior to `scsi_remove_host`, will leave dangling objects in `/sys/class/fc_remote_ports`. Access to any of these objects can result in a system crash !!!

Notes

This routine assumes no locks are held on entry.

Name

`fc_remote_port_add` — notify fc transport of the existence of a remote FC port.

Synopsis

```
struct fc_rport * fc_remote_port_add (struct Scsi_Host * shost, int
channel, struct fc_rport_identifiers * ids);
```

Arguments

shost scsi host the remote port is connected to.

channel Channel on shost port connected to.

ids The world wide names, fc address, and FC4 port roles for the remote port.

Description

The LLDD calls this routine to notify the transport of the existence of a remote port. The LLDD provides the unique identifiers (wwpn, wwn) of the port, its FC address (`port_id`), and the FC4 roles that are active for the port.

For ports that are FCP targets (aka scsi targets), the FC transport maintains consistent target id bindings on behalf of the LLDD. A consistent target id binding is an assignment of a target id to a remote port identifier, which persists while the scsi host is attached. The remote port can disappear, then later reappear, and its target id assignment remains the same. This allows for shifts in FC addressing (if binding by wwpn or wwnn) with no apparent changes to the scsi subsystem which is based on scsi host number and target id values. Bindings are only valid during the attachment of the scsi host. If the host detaches, then later re-attaches, target id bindings may change.

This routine is responsible for returning a remote port structure. The routine will search the list of remote ports it maintains internally on behalf of consistent target id mappings. If found, the remote port structure will be reused. Otherwise, a new remote port structure will be allocated.

Whenever a remote port is allocated, a new `fc_remote_port` class device is created.

Should not be called from interrupt context.

Notes

This routine assumes no locks are held on entry.

Name

`fc_remote_port_delete` — notifies the fc transport that a remote port is no longer in existence.

Synopsis

```
void fc_remote_port_delete (struct fc_rport * rport);
```

Arguments

rport The remote port that no longer exists

Description

The LLDD calls this routine to notify the transport that a remote port is no longer part of the topology. Note: Although a port may no longer be part of the topology, it may persist in the remote ports displayed by the `fc_host`. We do this under 2 conditions: 1) If the port was a scsi target, we delay its deletion by “blocking” it. This allows the port to temporarily disappear, then reappear without disrupting the SCSI device tree attached to it. During the “blocked” period the port will still exist. 2) If the port was a scsi target and disappears for longer than we expect, we’ll delete the port and the tear down the SCSI device tree attached to it. However, we want to semi-persist the target id assigned to that port if it eventually does exist. The port structure will remain (although with minimal information) so that the target id bindings remains.

If the remote port is not an FCP Target, it will be fully torn down and deallocated, including the `fc_remote_port` class device.

If the remote port is an FCP Target, the port will be placed in a temporary blocked state. From the LLDD's perspective, the `rport` no longer exists. From the SCSI midlayer's perspective, the SCSI target exists, but all sdevs on it are blocked from further I/O. The following is then expected.

If the remote port does not return (signaled by a LLDD call to `fc_remote_port_add`) within the `dev_loss_tmo` timeout, then the scsi target is removed - killing all outstanding i/o and removing the scsi devices attached to it. The port structure will be marked Not Present and be partially cleared, leaving only enough information to recognize the remote port relative to the scsi target id binding if it later appears. The port will remain as long as there is a valid binding (e.g. until the user changes the binding type or unloads the scsi host with the binding).

If the remote port returns within the `dev_loss_tmo` value (and matches according to the target id binding type), the port structure will be reused. If it is no longer a SCSI target, the target will be torn down. If it continues to be a SCSI target, then the target will be unblocked (allowing i/o to be resumed), and a scan will be activated to ensure that all luns are detected.

Called from normal process context only - cannot be called from interrupt.

Notes

This routine assumes no locks are held on entry.

Name

`fc_remote_port_rolechg` — notifies the fc transport that the roles on a remote may have changed.

Synopsis

```
void fc_remote_port_rolechg (struct fc_rport * rport, u32 roles);
```

Arguments

rport The remote port that changed.

roles New roles for this port.

Description

The LLDD calls this routine to notify the transport that the roles on a remote port may have changed. The largest effect of this is if a port now becomes a FCP Target, it must be allocated a scsi target id. If the port is no longer a FCP target, any scsi target id value assigned to it will persist in case the role changes back to include FCP Target. No changes in the scsi midlayer will be invoked if the role changes (in the expectation that the role will be resumed. If it doesn't normal error processing will take place).

Should not be called from interrupt context.

Notes

This routine assumes no locks are held on entry.

Name

`fc_block_scsi_eh` — Block SCSI eh thread for blocked `fc_rport`

Synopsis

```
int fc_block_scsi_eh (struct scsi_cmnd * cmd);
```

Arguments

cmd SCSI command that `scsi_eh` is trying to recover

Description

This routine can be called from a FC LLD `scsi_eh` callback. It blocks the `scsi_eh` thread until the `fc_rport` leaves the `FC_PORTSTATE_BLOCKED`, or the `fast_io_fail_tmo` fires. This is necessary to avoid the `scsi_eh` failing recovery actions for blocked rports which would lead to offlined SCSI devices.

Returns

0 if the `fc_rport` left the state `FC_PORTSTATE_BLOCKED`. `FAST_IO_FAIL` if the `fast_io_fail_tmo` fired, this should be passed back to `scsi_eh`.

Name

`fc_vport_create` — Admin App or LLDD requests creation of a vport

Synopsis

```
struct fc_vport * fc_vport_create (struct Scsi_Host * shost, int channel,  
struct fc_vport_identifiers * ids);
```

Arguments

shost scsi host the virtual port is connected to.

channel channel on shost port connected to.

ids The world wide names, FC4 port roles, etc for the virtual port.

Notes

This routine assumes no locks are held on entry.

Name

`fc_vport_terminate` — Admin App or LLDD requests termination of a vport

Synopsis

```
int fc_vport_terminate (struct fc_vport * vport);
```

Arguments

vport `fc_vport` to be terminated

Description

Calls the LLDD `vport_delete` function, then deallocates and removes the vport from the shost and object tree.

Notes

This routine assumes no locks are held on entry.

iSCSI transport class

The file `drivers/scsi/scsi_transport_iscsi.c` defines transport attributes for the iSCSI class, which sends SCSI packets over TCP/IP connections.

Name

`iscsi_create_flashnode_sess` — Add flashnode session entry in sysfs

Synopsis

```
struct iscsi_bus_flash_session * iscsi_create_flashnode_sess (struct  
Scsi_Host * shost, int index, struct iscsi_transport * transport, int  
dd_size);
```

Arguments

<i>shost</i>	pointer to host data
<i>index</i>	index of flashnode to add in sysfs
<i>transport</i>	pointer to transport data
<i>dd_size</i>	total size to allocate

Description

Adds a sysfs entry for the flashnode session attributes

Returns

pointer to allocated flashnode sess on success NULL on failure

Name

`iscsi_create_flashnode_conn` — Add flashnode conn entry in sysfs

Synopsis

```
struct iscsi_bus_flash_conn * iscsi_create_flashnode_conn (struct
Scsi_Host * shost, struct iscsi_bus_flash_session * fnode_sess, struct
iscsi_transport * transport, int dd_size);
```

Arguments

<i>shost</i>	pointer to host data
<i>fnode_sess</i>	pointer to the parent flashnode session entry
<i>transport</i>	pointer to transport data
<i>dd_size</i>	total size to allocate

Description

Adds a sysfs entry for the flashnode connection attributes

Returns

pointer to allocated flashnode conn on success NULL on failure

Name

`iscsi_is_flashnode_conn_dev` — verify passed device is to be flashnode conn

Synopsis

```
int iscsi_is_flashnode_conn_dev (struct device * dev, void * data);
```

Arguments

dev device to verify

data pointer to data containing value to use for verification

Description

Verifies if the passed device is flashnode conn device

Returns

1 on success 0 on failure

Name

`iscsi_find_flashnode_sess` — finds flashnode session entry

Synopsis

```
struct device * iscsi_find_flashnode_sess (struct Scsi_Host * shost,  
void * data, int (*fn) (struct device *dev, void *data));
```

Arguments

shost pointer to host data

data pointer to data containing value to use for comparison

fn function pointer that does actual comparison

Description

Finds the flashnode session object comparing the data passed using logic defined in passed function pointer

Returns

pointer to found flashnode session device object on success NULL on failure

Name

`iscsi_find_flashnode_conn` — finds flashnode connection entry

Synopsis

```
struct          device          *          iscsi_find_flashnode_conn          (struct  
iscsi_bus_flash_session * fnode_sess);
```

Arguments

fnode_sess pointer to parent flashnode session entry

Description

Finds the flashnode connection object comparing the data passed using logic defined in passed function pointer

Returns

pointer to found flashnode connection device object on success NULL on failure

Name

`iscsi_destroy_flashnode_sess` — destroy flashnode session entry

Synopsis

```
void iscsi_destroy_flashnode_sess (struct iscsi_bus_flash_session *  
  fnode_sess);
```

Arguments

fnode_sess pointer to flashnode session entry to be destroyed

Description

Deletes the flashnode session entry and all children flashnode connection entries from sysfs

Name

`iscsi_destroy_all_flashnode` — destroy all flashnode session entries

Synopsis

```
void iscsi_destroy_all_flashnode (struct Scsi_Host * shost);
```

Arguments

shost pointer to host data

Description

Destroys all the flashnode session entries and all corresponding children flashnode connection entries from sysfs

Name

`iscsi_scan_finished` — helper to report when running scans are done

Synopsis

```
int iscsi_scan_finished (struct Scsi_Host * shost, unsigned long time);
```

Arguments

shost scsi host

time scan run time

Description

This function can be used by drives like `qla4xxx` to report to the scsi layer when the scans it kicked off at module load time are done.

Name

`iscsi_block_scsi_eh` — block scsi eh until session state has transistioned

Synopsis

```
int iscsi_block_scsi_eh (struct scsi_cmnd * cmd);
```

Arguments

cmd scsi cmd passed to scsi eh handler

Description

If the session is down this function will wait for the recovery timer to fire or for the session to be logged back in. If the recovery timer fires then FAST_IO_FAIL is returned. The caller should pass this error value to the scsi eh.

Name

`iscsi_unblock_session` — set a session as logged in and start IO.

Synopsis

```
void iscsi_unblock_session (struct iscsi_cls_session * session);
```

Arguments

session iscsi session

Description

Mark a session as ready to accept IO.

Name

`iscsi_create_session` — create iscsi class session

Synopsis

```
struct iscsi_cls_session * iscsi_create_session (struct Scsi_Host *  
shost, struct iscsi_transport * transport, int dd_size, unsigned int  
target_id);
```

Arguments

<i>shost</i>	scsi host
<i>transport</i>	iscsi transport
<i>dd_size</i>	private driver data size
<i>target_id</i>	which target

Description

This can be called from a LLD or `iscsi_transport`.

Name

`iscsi_destroy_session` — destroy iscsi session

Synopsis

```
int iscsi_destroy_session (struct iscsi_cls_session * session);
```

Arguments

session iscsi_session

Description

Can be called by a LLD or `iscsi_transport`. There must not be any running connections.

Name

`iscsi_create_conn` — create iscsi class connection

Synopsis

```
struct iscsi_cls_conn * iscsi_create_conn (struct iscsi_cls_session *  
session, int dd_size, uint32_t cid);
```

Arguments

session iscsi cls session

dd_size private driver data size

cid connection id

Description

This can be called from a LLD or `iscsi_transport`. The connection is child of the session so `cid` must be unique for all connections on the session.

Since we do not support MCS, `cid` will normally be zero. In some cases for software iscsi we could be trying to preallocate a connection struct in which case there could be two connection structs and `cid` would be non-zero.

Name

`iscsi_destroy_conn` — destroy iscsi class connection

Synopsis

```
int iscsi_destroy_conn (struct iscsi_cls_conn * conn);
```

Arguments

conn iscsi cls session

Description

This can be called from a LLD or `iscsi_transport`.

Name

`iscsi_session_event` — send session destr. completion event

Synopsis

```
int iscsi_session_event (struct iscsi_cls_session * session, enum
iscsi_uevent_e event);
```

Arguments

session iscsi class session

event type of event

Serial Attached SCSI (SAS) transport class

The file `drivers/scsi/scsi_transport_sas.c` defines transport attributes for Serial Attached SCSI, a variant of SATA aimed at large high-end systems.

The SAS transport class contains common code to deal with SAS HBAs, an approximated representation of SAS topologies in the driver model, and various sysfs attributes to expose these topologies and management interfaces to userspace.

In addition to the basic SCSI core objects this transport class introduces two additional intermediate objects: The SAS PHY as represented by struct `sas_phy` defines an "outgoing" PHY on a SAS HBA or Expander, and the SAS remote PHY represented by struct `sas_rphy` defines an "incoming" PHY on a SAS Expander or end device. Note that this is purely a software concept, the underlying hardware for a PHY and a remote PHY is the exactly the same.

There is no concept of a SAS port in this code, users can see what PHYs form a wide port based on the `port_identifier` attribute, which is the same for all PHYs in a port.

Name

`sas_remove_children` — tear down a devices SAS data structures

Synopsis

```
void sas_remove_children (struct device * dev);
```

Arguments

dev device belonging to the sas object

Description

Removes all SAS PHYs and remote PHYs for a given object

Name

`sas_remove_host` — tear down a `Scsi_Host`'s SAS data structures

Synopsis

```
void sas_remove_host (struct Scsi_Host * shost);
```

Arguments

shost Scsi Host that is torn down

Description

Removes all SAS PHYs and remote PHYs for a given `Scsi_Host`. Must be called just before `sas_remove_host` for SAS HBAs.

Name

`sas_tlr_supported` — checking TLR bit in vpd 0x90

Synopsis

```
unsigned int sas_tlr_supported (struct scsi_device * sdev);
```

Arguments

sdev scsi device struct

Description

Check Transport Layer Retries are supported or not. If vpd page 0x90 is present, TRL is supported.

Name

`sas_disable_tlr` — setting TLR flags

Synopsis

```
void sas_disable_tlr (struct scsi_device * sdev);
```

Arguments

sdev scsi device struct

Description

Setting `tlr_enabled` flag to 0.

Name

`sas_enable_tlr` — setting TLR flags

Synopsis

```
void sas_enable_tlr (struct scsi_device * sdev);
```

Arguments

sdev scsi device struct

Description

Setting `tlr_enabled` flag 1.

Name

`sas_phy_alloc` — allocates and initialize a SAS PHY structure

Synopsis

```
struct sas_phy * sas_phy_alloc (struct device * parent, int number);
```

Arguments

parent Parent device

number Phy index

Description

Allocates an SAS PHY structure. It will be added in the device tree below the device specified by *parent*, which has to be either a `Scsi_Host` or `sas_rphy`.

Returns

SAS PHY allocated or NULL if the allocation failed.

Name

`sas_phy_add` — add a SAS PHY to the device hierarchy

Synopsis

```
int sas_phy_add (struct sas_phy * phy);
```

Arguments

phy The PHY to be added

Description

Publishes a SAS PHY to the rest of the system.

Name

`sas_phy_free` — free a SAS PHY

Synopsis

```
void sas_phy_free (struct sas_phy * phy);
```

Arguments

phy SAS PHY to free

Description

Frees the specified SAS PHY.

Note

This function must only be called on a PHY that has not successfully been added using `sas_phy_add`.

Name

`sas_phy_delete` — remove SAS PHY

Synopsis

```
void sas_phy_delete (struct sas_phy * phy);
```

Arguments

phy SAS PHY to remove

Description

Removes the specified SAS PHY. If the SAS PHY has an associated remote PHY it is removed before.

Name

`scsi_is_sas_phy` — check if a struct device represents a SAS PHY

Synopsis

```
int scsi_is_sas_phy (const struct device * dev);
```

Arguments

dev device to check

Returns

1 if the device represents a SAS PHY, 0 else

Name

`sas_port_add` — add a SAS port to the device hierarchy

Synopsis

```
int sas_port_add (struct sas_port * port);
```

Arguments

port port to be added

Description

publishes a port to the rest of the system

Name

`sas_port_free` — free a SAS PORT

Synopsis

```
void sas_port_free (struct sas_port * port);
```

Arguments

port SAS PORT to free

Description

Frees the specified SAS PORT.

Note

This function must only be called on a PORT that has not successfully been added using `sas_port_add`.

Name

`sas_port_delete` — remove SAS PORT

Synopsis

```
void sas_port_delete (struct sas_port * port);
```

Arguments

port SAS PORT to remove

Description

Removes the specified SAS PORT. If the SAS PORT has an associated phys, unlink them from the port as well.

Name

`scsi_is_sas_port` — check if a struct device represents a SAS port

Synopsis

```
int scsi_is_sas_port (const struct device * dev);
```

Arguments

dev device to check

Returns

1 if the device represents a SAS Port, 0 else

Name

`sas_port_get_phy` — try to take a reference on a port member

Synopsis

```
struct sas_phy * sas_port_get_phy (struct sas_port * port);
```

Arguments

port port to check

Name

`sas_port_add_phy` — add another phy to a port to form a wide port

Synopsis

```
void sas_port_add_phy (struct sas_port * port, struct sas_phy * phy);
```

Arguments

port port to add the phy to

phy phy to add

Description

When a port is initially created, it is empty (has no phys). All ports must have at least one phy to operated, and all wide ports must have at least two. The current code makes no difference between ports and wide ports, but the only object that can be connected to a remote device is a port, so ports must be formed on all devices with phys if they're connected to anything.

Name

`sas_port_delete_phy` — remove a phy from a port or wide port

Synopsis

```
void sas_port_delete_phy (struct sas_port * port, struct sas_phy * phy);
```

Arguments

port port to remove the phy from

phy phy to remove

Description

This operation is used for tearing down ports again. It must be done to every port or wide port before calling `sas_port_delete`.

Name

`sas_end_device_alloc` — allocate an rphy for an end device

Synopsis

```
struct sas_rphy * sas_end_device_alloc (struct sas_port * parent);
```

Arguments

parent which port

Description

Allocates an SAS remote PHY structure, connected to *parent*.

Returns

SAS PHY allocated or NULL if the allocation failed.

Name

`sas_expander_alloc` — allocate an rphy for an end device

Synopsis

```
struct sas_rphy * sas_expander_alloc (struct sas_port * parent, enum
sas_device_type type);
```

Arguments

parent which port

type SAS_EDGE_EXPANDER_DEVICE or SAS_FANOUT_EXPANDER_DEVICE

Description

Allocates an SAS remote PHY structure, connected to *parent*.

Returns

SAS PHY allocated or NULL if the allocation failed.

Name

`sas_rphy_add` — add a SAS remote PHY to the device hierarchy

Synopsis

```
int sas_rphy_add (struct sas_rphy * rphy);
```

Arguments

rphy The remote PHY to be added

Description

Publishes a SAS remote PHY to the rest of the system.

Name

`sas_rphy_free` — free a SAS remote PHY

Synopsis

```
void sas_rphy_free (struct sas_rphy * rphy);
```

Arguments

rphy SAS remote PHY to free

Description

Frees the specified SAS remote PHY.

Note

This function must only be called on a remote PHY that has not successfully been added using `sas_rphy_add` (or has been `sas_rphy_remove'd`)

Name

`sas_rphy_delete` — remove and free SAS remote PHY

Synopsis

```
void sas_rphy_delete (struct sas_rphy * rphy);
```

Arguments

rphy SAS remote PHY to remove and free

Description

Removes the specified SAS remote PHY and frees it.

Name

`sas_rphy_unlink` — unlink SAS remote PHY

Synopsis

```
void sas_rphy_unlink (struct sas_rphy * rphy);
```

Arguments

rphy SAS remote phy to unlink from its parent port

Description

Removes port reference to an rphy

Name

`sas_rphy_remove` — remove SAS remote PHY

Synopsis

```
void sas_rphy_remove (struct sas_rphy * rphy);
```

Arguments

rphy SAS remote phy to remove

Description

Removes the specified SAS remote PHY.

Name

`scsi_is_sas_rphy` — check if a struct device represents a SAS remote PHY

Synopsis

```
int scsi_is_sas_rphy (const struct device * dev);
```

Arguments

dev device to check

Returns

1 if the device represents a SAS remote PHY, 0 else

Name

`sas_attach_transport` — instantiate SAS transport template

Synopsis

```
struct    scsi_transport_template    *    sas_attach_transport    (struct  
sas_function_template * ft);
```

Arguments

ft SAS transport class function template

Name

`sas_release_transport` — release SAS transport template instance

Synopsis

```
void sas_release_transport (struct scsi_transport_template * t);
```

Arguments

t transport template instance

SATA transport class

The SATA transport is handled by libata, which has its own book of documentation in this directory.

Parallel SCSI (SPI) transport class

The file `drivers/scsi/scsi_transport_spi.c` defines transport attributes for traditional (fast/wide/ultra) SCSI busses.

Name

`spi_schedule_dv_device` — schedule domain validation to occur on the device

Synopsis

```
void spi_schedule_dv_device (struct scsi_device * sdev);
```

Arguments

sdev The device to validate

Description

Identical to `spi_dv_device` above, except that the DV will be scheduled to occur in a workqueue later. All memory allocations are atomic, so may be called from any context including those holding SCSI locks.

Name

`spi_display_xfer_agreement` — Print the current target transfer agreement

Synopsis

```
void spi_display_xfer_agreement (struct scsi_target * starget);
```

Arguments

starget The target for which to display the agreement

Description

Each SPI port is required to maintain a transfer agreement for each other port on the bus. This function prints a one-line summary of the current agreement; more detailed information is available in sysfs.

Name

`spi_populate_tag_msg` — place a tag message in a buffer

Synopsis

```
int spi_populate_tag_msg (unsigned char * msg, struct scsi_cmnd * cmd);
```

Arguments

msg pointer to the area to place the tag

cmd pointer to the scsi command for the tag

Notes

designed to create the correct type of tag message for the particular request. Returns the size of the tag message. May return 0 if TCQ is disabled for this device.

SCSI RDMA (SRP) transport class

The file `drivers/scsi/scsi_transport_srp.c` defines transport attributes for SCSI over Remote Direct Memory Access.

Name

`srp_tmo_valid` — check timeout combination validity

Synopsis

```
int srp_tmo_valid (int reconnect_delay, int fast_io_fail_tmo, int  
dev_loss_tmo);
```

Arguments

reconnect_delay Reconnect delay in seconds.

fast_io_fail_tmo Fast I/O fail timeout in seconds.

dev_loss_tmo Device loss timeout in seconds.

Description

The combination of the timeout parameters must be such that SCSI commands are finished in a reasonable time. Hence do not allow the fast I/O fail timeout to exceed `SCSI_DEVICE_BLOCK_MAX_TIMEOUT` nor allow `dev_loss_tmo` to exceed that limit if failing I/O fast has been disabled. Furthermore, these parameters must be such that multipath can detect failed paths timely. Hence do not allow all three parameters to be disabled simultaneously.

Name

`srp_start_tl_fail_timers` — start the transport layer failure timers

Synopsis

```
void srp_start_tl_fail_timers (struct srp_rport * rport);
```

Arguments

rport SRP target port.

Description

Start the transport layer fast I/O failure and device loss timers. Do not modify a timer that was already started.

Name

`srp_reconnect_rport` — reconnect to an SRP target port

Synopsis

```
int srp_reconnect_rport (struct srp_rport * rport);
```

Arguments

rport SRP target port.

Description

Blocks SCSI command queueing before invoking `reconnect` such that `queuecommand` won't be invoked concurrently with `reconnect` from outside the SCSI EH. This is important since a `reconnect` implementation may reallocate resources needed by `queuecommand`.

Notes

- This function neither waits until outstanding requests have finished nor tries to abort these. It is the responsibility of the `reconnect` function to finish outstanding commands before reconnecting to the target port.
- It is the responsibility of the caller to ensure that the resources reallocated by the `reconnect` function won't be used while this function is in progress. One possible strategy is to invoke this function from the context of the SCSI EH thread only. Another possible strategy is to lock the `rport` mutex inside each SCSI LLD callback that can be invoked by the SCSI EH (the `scsi_host_template.eh_*`() functions and also the `scsi_host_template.queuecommand` function).

Name

`srp_rport_get` — increment rport reference count

Synopsis

```
void srp_rport_get (struct srp_rport * rport);
```

Arguments

rport SRP target port.

Name

`srp_rport_put` — decrement rport reference count

Synopsis

```
void srp_rport_put (struct srp_rport * rport);
```

Arguments

rport SRP target port.

Name

`srp_rport_add` — add a SRP remote port to the device hierarchy

Synopsis

```
struct srp_rport * srp_rport_add (struct Scsi_Host * shost, struct  
srp_rport_identifiers * ids);
```

Arguments

shost scsi host the remote port is connected to.

ids The port id for the remote port.

Description

Publishes a port to the rest of the system.

Name

`srp_rport_del` — remove a SRP remote port

Synopsis

```
void srp_rport_del (struct srp_rport * rport);
```

Arguments

rport SRP remote port to remove

Description

Removes the specified SRP remote port.

Name

`srp_remove_host` — tear down a `Scsi_Host`'s SRP data structures

Synopsis

```
void srp_remove_host (struct Scsi_Host * shost);
```

Arguments

shost Scsi Host that is torn down

Description

Removes all SRP remote ports for a given `Scsi_Host`. Must be called just before `scsi_remove_host` for SRP HBAs.

Name

`srp_stop_rport_timers` — stop the transport layer recovery timers

Synopsis

```
void srp_stop_rport_timers (struct srp_rport * rport);
```

Arguments

rport SRP remote port for which to stop the timers.

Description

Must be called after `srp_remove_host` and `scsi_remove_host`. The caller must hold a reference on the `rport` (`rport->dev`) and on the SCSI host (`rport->dev.parent`).

Name

`srp_attach_transport` — instantiate SRP transport template

Synopsis

```
struct    scsi_transport_template    *    srp_attach_transport    (struct  
srp_function_template * ft);
```

Arguments

ft SRP transport class function template

Name

`srp_release_transport` — release SRP transport template instance

Synopsis

```
void srp_release_transport (struct scsi_transport_template * t);
```

Arguments

t transport template instance

Chapter 4. SCSI lower layer

Host Bus Adapter transport types

Many modern device controllers use the SCSI command set as a protocol to communicate with their devices through many different types of physical connections.

In SCSI language a bus capable of carrying SCSI commands is called a "transport", and a controller connecting to such a bus is called a "host bus adapter" (HBA).

Debug transport

The file `drivers/scsi/scsi_debug.c` simulates a host adapter with a variable number of disks (or disk like devices) attached, sharing a common amount of RAM. Does a lot of checking to make sure that we are not getting blocks mixed up, and panics the kernel if anything out of the ordinary is seen.

To be more realistic, the simulated devices have the transport attributes of SAS disks.

For documentation see <http://sg.danny.cz/sg/sdebug26.html>

todo

Parallel (fast/wide/ultra) SCSI, USB, SATA, SAS, Fibre Channel, FireWire, ATAPI devices, Infiniband, I20, iSCSI, Parallel ports, netlink...